

55 minutes  
Marks

Closed Book

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5 1. Consider the three classes, D, A, and B, given below. For each of the statements in make of D, indicated whether it would cause a syntax error, a run-time error, or give any output produced it (assuming valid statements above it have been executed). Note that A and B compile correctly.

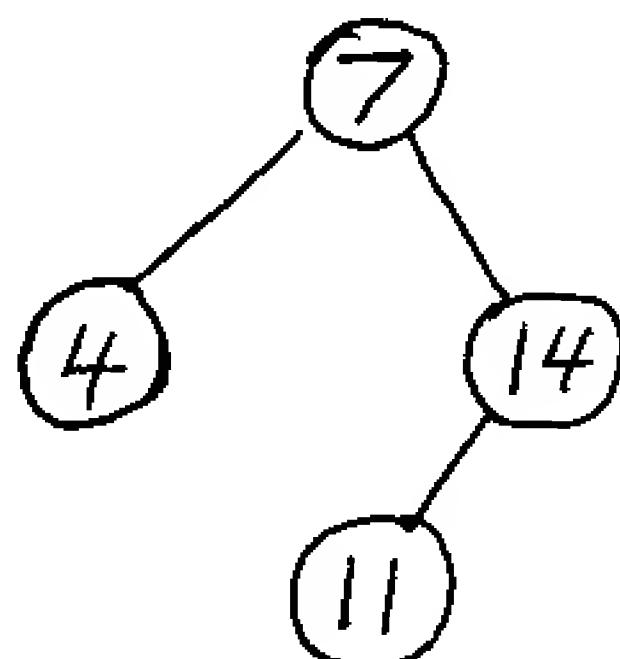
class D  
creation make  
feature  
s : A  
r : B  
make is  
do  
!!r.make  
s := r  
s.p  
s.q  
r := s  
end  
end -- D

class A  
creation make  
feature  
make is  
do  
end  
p is  
do  
io.put\_string("x")  
end  
end -- A

class B  
inherit  
A  
rename p as q  
redefine q  
end  
creation make  
feature  
p is  
do  
io.put\_string("y")  
end  
q is  
do  
io.put\_string("z")  
end  
end -- B

5 2. Consider a hash table using open addressing when many insertions and deletions done to it. Assume that its' load factor remains about the same. What happens to the value of its' expected length of search for failing searches as more and more operations are done? Why does this happen? What can be done from time to time to reduce this problem?

5 3. Consider the height-balanced tree show below. Draw a diagram of the tree after the insertion of the value 9 (and any resulting rotations have been done). Draw a diagram of the tree after a further insertion of the value 8 (and any resulting rotations have been done). Note that insertion of 8 is into the tree that results from the insertion of 9.



5 4. From perspective of least worst-case time, which is the best approach for inserting and searching for values in a dictionary: weight-balanced tree, hash table, height-balanced tree, or standard ordered binary tree. **Briefly** justify your answer.

25 5. Suppose that a charitable organization has decided to run a betting pool on the result of an important sports game (say The Grey Cup). To facilitate determining the status of the bets so far, and for quick determination of the payout, you have been given the task of developing a system for it. For this question you are to do part of the analysis and design for developing an object-oriented version of the system.

In more detail, assume the game is between team A and team B. Instead of betting on the final score of the game, betters will bet on the difference between the score of A and the score of B. Of course, this can be positive or negative dependent upon who won. Those who bet on the winning difference (or the closest difference to the winning difference) share 3/4 of the total amount bet. (The other 1/4 goes to the charity running the betting pool.) A winners share is determined by how much they bet on the winning difference as compared with the total amount bet on the winning difference. At the end of the game, the system should determine how much money is owed to each winning better. Also customers like to know how the odds are shaping up. Thus at any time prior to the game, a customer can inquire as to what the payout would be for the next dollar bet on a specified difference if that difference were the winning one.

Customers place their bets prior to the start of the game. They can bet as much money on as many differences as they would like. As the organization will be trying to obtain bets over a length of time, they decided to allow each customer to inquire about what bets they have already made.

You are to do parts of the analysis and design for the system. In doing your data structures design, do it so that as little searching as possible is needed to respond to inquiries.

- (a) Give a context diagram for your system.
- (b) Give a scenario diagram for a customer placing a bet.
- (c) What classes will you need? Either use very descriptive titles or include a couple words to describe each?
- (d) Describe **in detail** the data structures that you would use in order to be able to quickly respond to any inquiries.

Note that after doing part (d), you might want to do minor modifications to your answers to previous parts (as systems analysis and design is an iterative process).

Note that no code is required.